

**NHI COURSE 132012  
SOILS AND FOUNDATIONS WORKSHOP  
PARTICIPANT WORKBOOK**

## **1.0 INTRODUCTION**

Through the Indefinite Quantity Contract No. DTFH-61-97-D00025, Parsons Brinckerhoff Quade & Douglas, Inc. (PB) was retained by NHI/FHWA to develop the curriculum materials and revise the existing NHI course 13212 "Soils and Foundations Workshop" per Task Order 99-T-25048. The purpose is to revise the existing 4-day course presentation to an interactive format so the learner is actively involved in the learning experience based on the approved Preliminary Lesson Plans.

The Soils and Foundations Workshop is a basic geotechnical course which will provide practical knowledge for both generalists and those planning to take more advanced geotechnical courses in the future. The workshop will be of most benefit to bridge and foundation engineers; particularly those involved in the design and construction aspects of highway projects. The course objective is to impart to the participants the necessary knowledge and skills to determine the minimum level of geotechnical effort needed on a highway project. The participants will develop knowledge and appreciation of foundation activities in all project phases.

## **2.0 COURSE ORGANIZATION**

The course will be presented by FHWA-approved instructors using a Participant Workbook, a Reference Manual, and various visual aids such as slides, transparencies, computer projections, and similar tools. The course is designed to begin at 1:00 PM on Monday and end at noon on Friday. Presentations by representatives of the host agency are planned for Monday PM and Friday AM in addition to a laboratory exercise in the agency soils lab on Tuesday AM. The detailed course agenda is presented in Section 3.0.

All participants will be provided with a copy of the Reference Manual and Participant Workbook. The Reference Manual, which was based on the 2<sup>nd</sup> edition of the previous Workshop Manual (1993), is geared to the practicing engineer who routinely deals with soils and/or foundations but has little theoretical background in soil mechanics or foundation engineering. The manual content follows a project oriented approach whereby the actual foundation work for a bridge project is traced from preparation of the boring request, to laboratory work, through design computations to construction activities. Recommendations are presented on how to efficiently layout borings, how to minimize approach embankment settlement, how to design the most cost-effective pile foundation, and how to transmit design information properly to construction. Reference Manual will be referred to from time to time during the course so that the participants can become familiar with its contents.

This Participant Workbook includes copies of visual aids and student exercises that closely follows the presentations being made by the instructors. The student exercises are designed to promote the interaction in the classroom, and to illustrate the basic principles and analyses. Solutions to the exercises are included in the back of the workbook.

The course is divided into ten (10) distinct lessons, as shown in the following table. The sequence of lessons follows the order of presentations in both the Reference Manual and the Participant Workbook. The times for each topic may be varied by the instructor based on special interest by the audience in certain topic areas.

Lesson No.	Title	TIME	DAY
1.	Topic 1 - Introduction to Soils and Foundations Workshop	10 min	One
	Topic 2 - General Overview of Geotechnical Input to Highway Projects	60 min	One
2.	Topic 1 – Site Investigation and Sampling Methods in Highway Engineering – Chapter 2 (w/ state presentation)	100 min	One
	Topic 2 – Layout of Subsurface Investigation for a Bridge Foundation - Chapter 2	25 min	Two
3.	Basic Soil Properties for Foundation Design-Chapter 3 (w/ Lab. Session)	200 min	Two
4.	Laboratory Testing for Foundation Design-Chapter 4	115 min	Two
5.	Topic 1 – Slope Stability – Chapter 5	165 min	Two & Three
	Topic 2 – Solutions to Slope Instability – Chapter 5	80 min	Three
6.	Topic 1 – Embankment Settlement – Chapter 6	135 min	Three
	Topic 2 – Treatment for Embankment Settlement – Chapter 6	30 min	Three
7.	Topic 1 – Spread Footing Design- Bearing Capacity – Chapter 7	85 min	Three
	Topic 2 – Spread Footing Design-Settlement – Chapter 7	75 min	Four
8.	Topic 1 – Deep Foundation Design – Load Capacity – Chapter 8	155 min	Four
	Topic 2 – Deep Foundation Design – Pile Groups – Chapter 8	60 min	Four
9.	Topic 1 – Construction Control Considerations – Instrumentation - Chapter 9	40 min	Four
	Topic 2 – Construction Control Considerations – Foundations – Chapter 9 (w/ Two Breaks)	120 min	Four & Five
	Topic 3 – Construction Control Considerations – Pile Load Testing – Chapter 9	45 min	Five
10.	Foundation Investigation Report-Chapter 10 (w/ state presentation)	65 min	Five
11.	Team Exercises, Course Summary, Review, and Critique	60 min	Five

### 3.0 COURSE AGENDA

#### DAY ONE P.M.

1:00 p.m.	Welcome Administrative Details	<b>State Representative</b>
1:15 p.m.	Lesson 1: Topic 1 Introduction to the Soils & Foundations Workshop	<i>1<sup>st</sup> Instructor</i>
	Lesson 1: Topic 2 General Overview of the Geotechnical Input to Highway Projects	<i>1<sup>st</sup> Instructor</i>
2:25 p.m.	BREAK	
2:40 p.m.	Lesson 2: Topic 1 Site Investigation Exploration and Sampling Methods	<i>2<sup>nd</sup> Instructor</i>
3:50 p.m.	MINI BREAK	
4:00 p.m.	Typical Foundation Exploration Program Done by Host Agency	<b>State Representative</b>
4:30 p.m.	CLOSING	

**Wear work clothes to Tuesday a.m. lab sessions**

**\*\* Hands-on student exercise problems begin Tuesday - bring calculators.**

## DAY TWO

8:00 a.m.	Lesson 2: Topic 2 How to Lay Out Subsurface Exploration Program for a Bridge Foundation	1 <sup>st</sup> Instructor
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8:25 a.m.	Lesson 3: Introduction to Soil Testing	1 <sup>st</sup> Instructor
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9:10 a.m.	Review Foundation Design Objectives A. Discuss Processing of Soil Samples in Lab B. Visual Soil Description System ("MUD")	1 <sup>st</sup> Instructor
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9:30 a.m.	BREAK	
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### GO TO DOT LABORATORY

9:45 am	Students Visual Soil Identification Exercise in DOT Lab.	<b>Instructors &amp;</b>
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& 10:45 a.m.	Lab Walk-Thru and Demonstration of Test Methods	<b>Host Lab Personnel</b>
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### RETURN TO MAIN CLASSROOM

11:30 a.m.	Lesson 3 (Cont'd.) Discussion of Lab Exercise ** GEOQUIZ	1 <sup>st</sup> Instructor
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12:00 p.m.	LUNCH	
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1:00 p.m.	Lesson 4: Selection of Soil Design Parameters A. Effective Stress Principle B. Po Diagram * C. Po Diagram – Student Exercise	1 <sup>st</sup> Instructor
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2:00 p.m.	BREAK	
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2:15 p.m.	Lesson 4 (cont'd): Lab Testing Program Developed D. Consolidation Tests for Settlement E. Strength Tests for Stability and Bearing Capacity F. Apple Freeway Design Problem	1 <sup>st</sup> Instructor
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3:10 p.m.	MINI BREAK	
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3:15 p.m.	Lesson 5: Topic 1 Slope Stability	2 <sup>nd</sup> Instructor
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- A. Circular Arc Failure
- \*\*B. Student Mini-Exercise

4:30 p.m. CLOSING

### DAY THREE

8:00 a.m. Lesson 5: Topic 1 (Cont'd) *2<sup>nd</sup> Instructor*  
 C. Sliding Block Failure  
 \*\*D. Sliding Block - Student Exercise

Demonstrate Slope Stability Computer Program *1<sup>st</sup> Instructor*

9:15 am BREAK

9:30 am Lesson 5: Topic 2 Solutions to Slope Instability *2<sup>nd</sup> Instructor*  
 A. Design Solutions to Stability Problems  
 B. Cut Slope Stability  
 C. Lateral Squeeze  
 \*\*D. Student Mini-Exercise- Stability Solutions  
 E. Apple Freeway Workshop Design Problem

10:50 a.m. MINI-BREAK

11:00 a.m. Lesson 6: Topic 1 Embankment Settlement *2<sup>nd</sup> Instructor*  
 A. Major Design Considerations Settlement Amount and Time  
 B. Embankment Pressure Distribution

12:00 p.m. LUNCH

1:00 p.m. C. Settlement Analysis - Granular Soils *2<sup>nd</sup> Instructor*  
 \*\*D. Student Mini-Exercise - SPT Correction and "C" Value  
 E. Settlement Analysis - Cohesive Soils  
 \*\*F. Student Exercise - Settlement and Time Estimate for Embankment Over Clay  
 Demonstration of EMBANK Program

2:15 p.m. BREAK

2:30 p.m. Lesson 6: Topic 2 Treatments for Embankment Settlement Problems *2<sup>nd</sup> Instructor*  
 A. Methods To Reduce Settlement Amount And/Or Time

B. Lateral Squeeze Settlement Analysis –  
Apple Freeway Workshop Design Problem

3:00 p.m.	MINI-BREAK	
3:05 p.m.	Lesson 7: Topic 1 Spread Footing Design; Bearing Capacity A. Bearing Capacity of Spread Footings **B. Student Exercise - Bearing Capacity	1 <sup>st</sup> Instructor
4:30 p.m.	CLOSING	

**DAY FOUR**

8:00 a.m.	Lesson 7: Topic 2 Spread Footing Design; Settlement A. Settlement of Spread Footings **B. Student Exercise - Footing Settlement  Apple Freeway Workshop Design Problem C. Footing Bearing Capacity D. Footing Settlement	1 <sup>st</sup> Instructor
9:15 a.m.	BREAK	
9:30 a.m.	Lesson 8: Topic 1 Deep Foundation Design - Load Capacity A. Granular Soils (Nordlund's Method)	1 <sup>st</sup> Instructor
10:30 a.m.	MINI-BREAK	
10:40 a.m.	B. Cohesive Soils (Tomlinson's Method) **C. Student Exercise - Static Analysis	1 <sup>st</sup> Instructor
12:00 p.m.	LUNCH	
1:00 p.m.	Demonstration of SPILE/DRIVEN Programs	1 <sup>st</sup> Instructor
1:15 p.m.	Lesson 8: Topic 2 Deep Foundation Design -Pile Groups  Workshop Problem - Pile Design	1 <sup>st</sup> Instructor
2:15 p.m.	BREAK	

2:30 p.m.	Session 9: Topic 1 Construction Aspects— Instrumentation	<i>2<sup>nd</sup> Instructor</i>
3:10 p.m.	Mini-BREAK	
3: 15 p.m.	Session 9: Topic 2 Construction Aspects— Foundations A. Pile Driving Equipment B. Pile Driving Formula C. Dynamic Analysis/Wave Equation Introduction **D. Student Exercise – Pile Driveability	<i>1<sup>st</sup> Instructor</i>
4:30 p.m.	CLOSING	

#### **DAY FIVE A.M.**

8:00 a.m.	Session 9: Topic 2 Construction Aspects (Cont'd) **E. Student Exercise - Hammer Approval F. Apple Freeway Workshop Design Problem	<i>1<sup>st</sup> Instructor</i>
8:45 a.m.	Lesson 9: Topic 3 Construction Aspects -Pile Load Testing ** Student Exercise – Load Test Interpretation	<i>2<sup>nd</sup> Instructor</i>
9:30 a.m.	BREAK	
9:45 a.m.	DOT FOUNDATION REPORTS How field data are used. Alternates considered. Analysis methods used. Information presented in Foundation Report. Information presented in Plans and Specifications. Designer Utilization of Foundation Data.	<b>State Representative</b>
10:20 a.m.	MINI-BREAK	
10:30 a.m.	Lesson 10: Foundation Investigation Report A. Guidelines for Writing a Good Report B. What the Report Should Contain C. Use of Special Notes D. Information Made Available to Contractor E. Use of “Disclaimers”	<i>2<sup>nd</sup> Instructor</i>

Workshop Design Problem – Foundation  
Investigation Report

11:00 a.m.

Team Problem Session  
Group Discussion of Workshop Learning  
Objectives  
Complete Course Critique Forms

*ALL*

CLOSING